*Supporting Information*

# Multi-Walled Carbon Nanotube-assisted Encapsulation Approach for Stable Perovskite Solar Cells

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## 1. Light Absorbance Stability of Devices

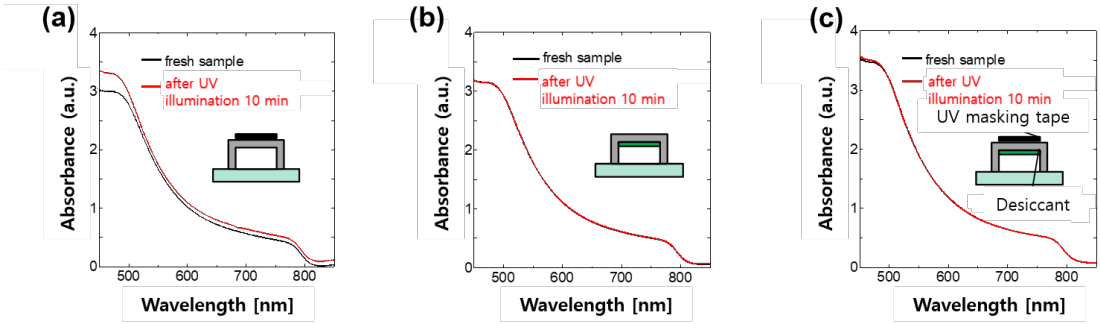



**Figure S1.** (**a**–**c**) Light absorbance of the perovskite film before and after UV illumination for 10 minutes in three different encapsulation structures: (**a**) with a UV masking, (**b**) with a desiccant (getter), and (**c**) with both a UV masking and a desiccant.

## 2. Encapsulation Approaches

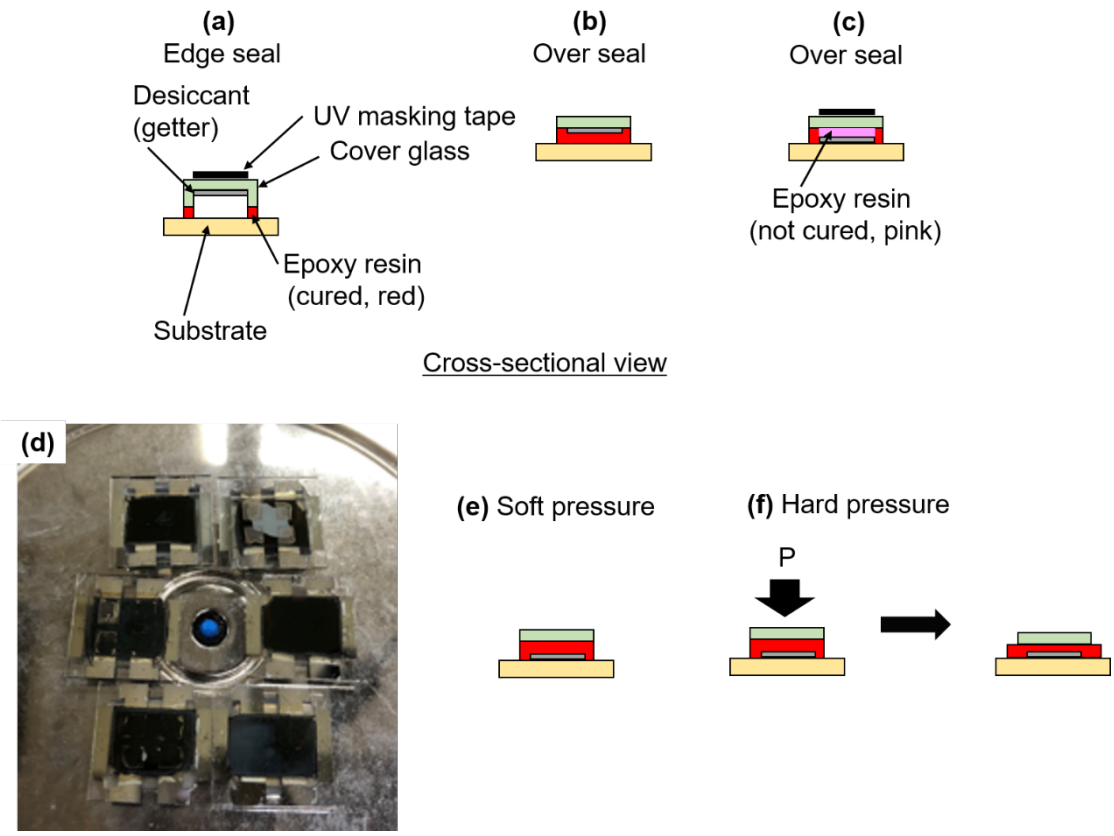



**Figure S2.** (**a–c**) Three different encapsulation structures: (**a**) edge sealing with both a desiccant and a UV masking tape, (**b**) over sealing with only a desiccant, and (**c**) over sealing with both a desiccant and a UV masking tape, which leaves the centre of epoxy resin not cured; (**d**) Photographic image of the devices made by the suggested structures; (**e–f**) Two different pressures applied during the packaging.

### 3. Stability of Devices with Different Passivation Structures

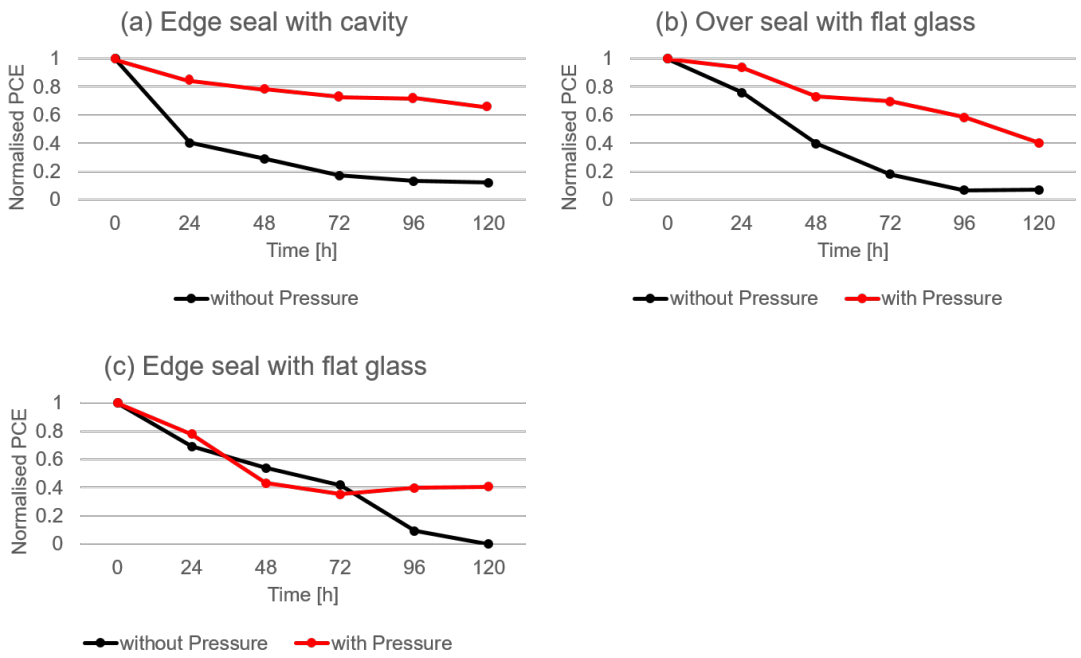



**Figure S3.** Normalised power conversion efficiency of the (**a**) edge seal with cavity; (**b**) over seal with flat glass; and (**c**) edge seal with flat glass during 120 min stability test.

## 4. Devices with Different Structures

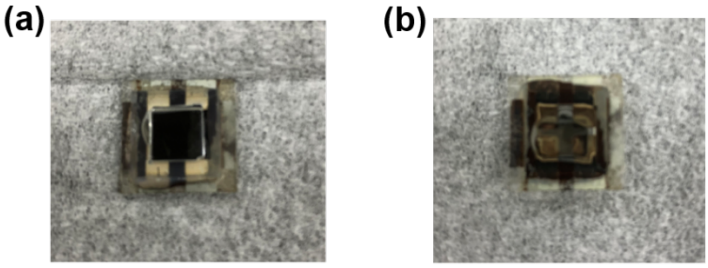



**Figure S4.** Photographic images of (**a**) edge seal- and (**b**) over seal-encapsulated samples.

## 5. Devices with Different Applied Pressures

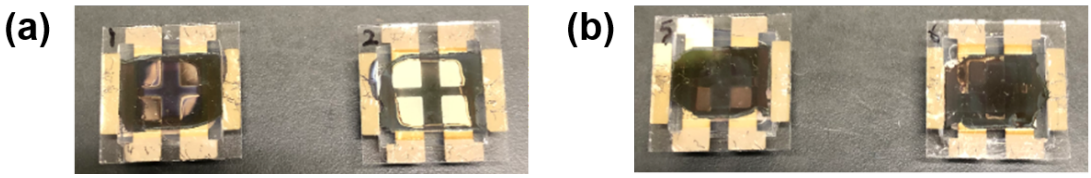



**Figure S5.** Images before and after one week of durability testing: (**a**) 4.90 N cm$^{-2}$ pressure- and (**b**) 14.71 N cm$^{-2}$ pressure-encapsulated perovskite solar cells**.**

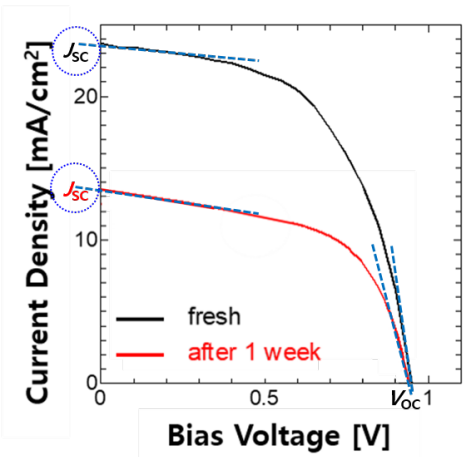
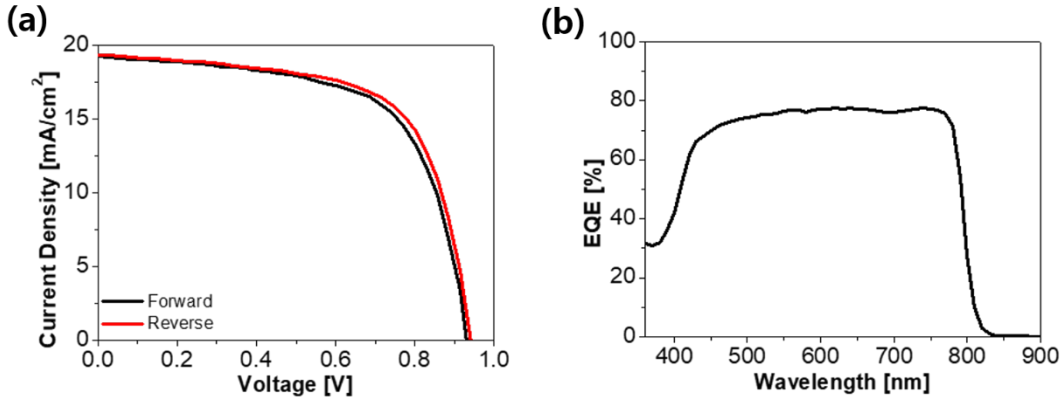



**Figure S6.** *J–V* curves of the encapsulated PSCs under 14.71 N cm$^{-2}$ with a nitrogen gun blown constantly during the stability test to keep the device temperature low.

## 6. Performance of Unencapsulated Devices




| Bias | $J_{SC}$ [mA/cm$^2$] | $V_{OC}$ [V] | FF | PCE [%] |
|---|---|---|---|---|
| Forward | 19.26 | 0.93 | 63.76 | 11.46 |
| Reverse | 19.36 | 0.94 | 64.83 | 11.84 |

**Figure S7.** (**a**) Forward and reverse bias *J–V* curves, (**b**) EQE, and photovoltaic table of the unencapsulated PSCs,

## 7. Images of MWNT-added UV-epoxy resin

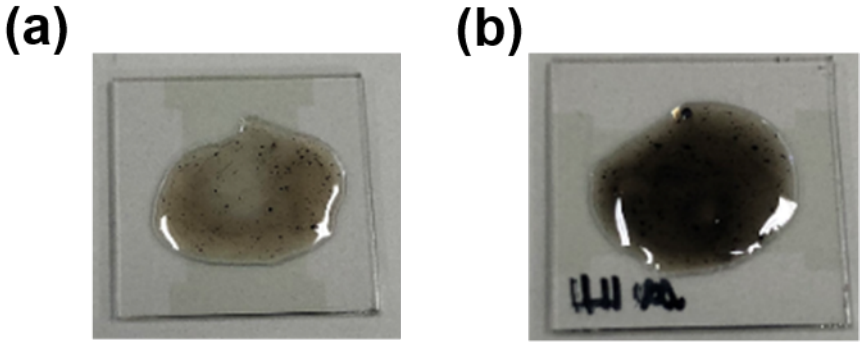
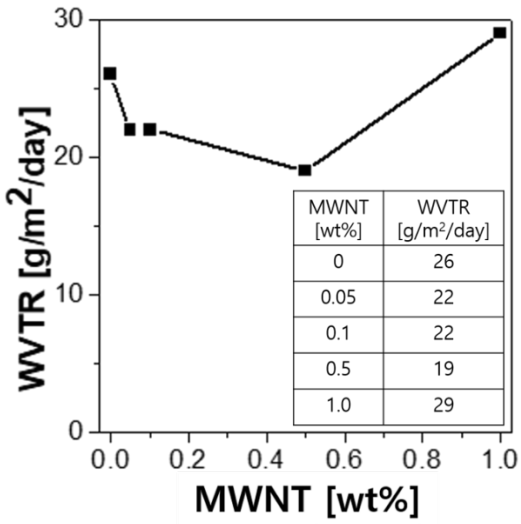



**Figure S8.** Images of (**a**) 0.5-wt%; and (**b**) 1.5-wt% multi-walled nanotube (MWNT)-added UV epoxy resin.

**8. Water vapour transmittance rate (WVTR) Data**




| MWNT [wt%] | WVTR [g/m²/day] |
|---|---|
| 0 | 26 |
| 0.05 | 22 |
| 0.1 | 22 |
| 0.5 | 19 |
| 1.0 | 29 |

**Figure S9.** Water vapour transmittance rate (WVTR) of the MWNT-added UV epoxy resin with respect to the wt% of the MWNT.

## 9. WVTR Sample Preparation

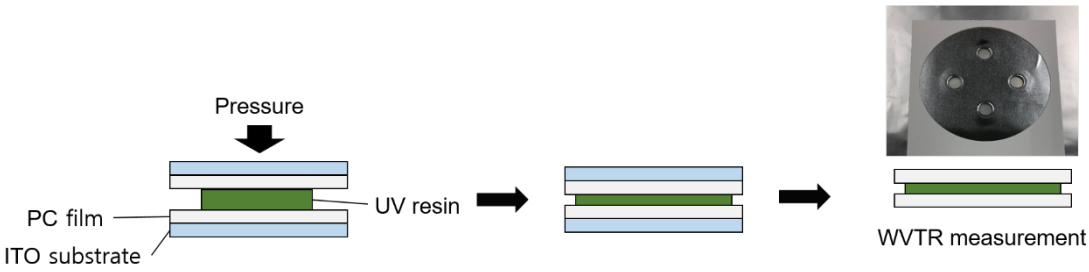
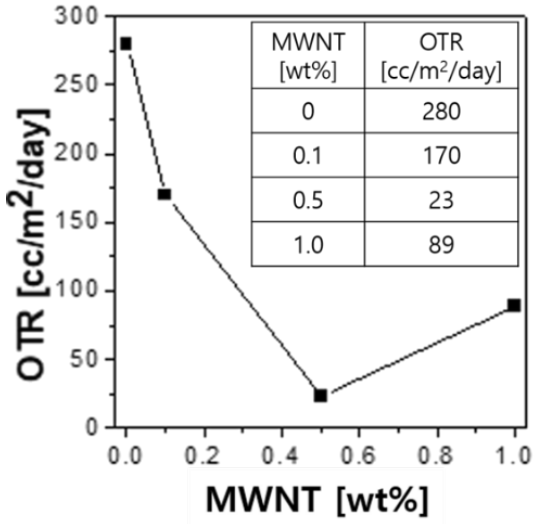



**Figure S10.** Schematic of the sample preparation for the WVTR measurement.

**10. Oxygen transmittance rate (OTR) Data**




| MWNT [wt%] | OTR [cc/m²/day] |
|---|---|
| 0 | 280 |
| 0.1 | 170 |
| 0.5 | 23 |
| 1.0 | 89 |

**Figure S11.** Oxygen transmittance rate (OTR) of the MWNT-added UV epoxy resin with respect to the wt% of the MWNT.

## 11. $J_{SC}$ and $V_{OC}$ during Stability Test

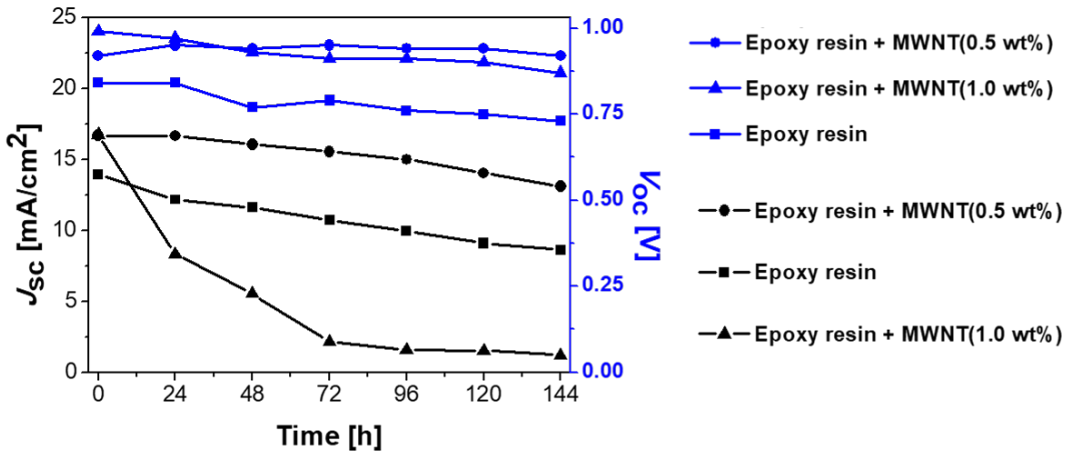
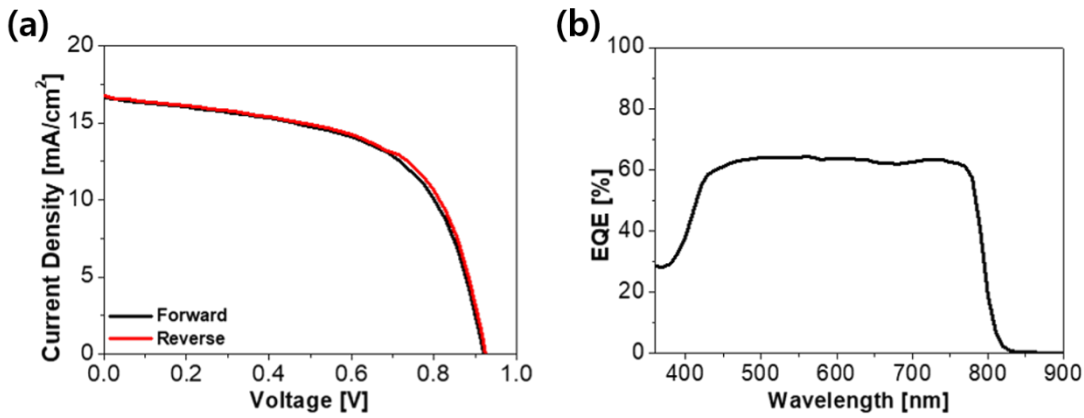



**Figure S12.** $J_{SC}$ and $V_{OC}$ of the 0, 0.5, and 1.0 wt% of MWNT-added UV epoxy resin.

## 12. Performance of 0.5 wt% MWNT-added Encapsulated Devices




| Bias | $J_{SC}$ [mA/cm$^2$] | $V_{OC}$ [V] | FF | PCE [%] |
|---|---|---|---|---|
| Forward | 16.6 | 0.91 | 59.1 | 8.93 |
| Reverse | 16.7 | 0.92 | 60.1 | 9.24 |

**Figure S13.** (**a**) Forward and reverse bias *J*–*V* curves, (**b**) EQE, and photovoltaic table of the 0.5 wt% MWNT-added encapsulated PSCs.

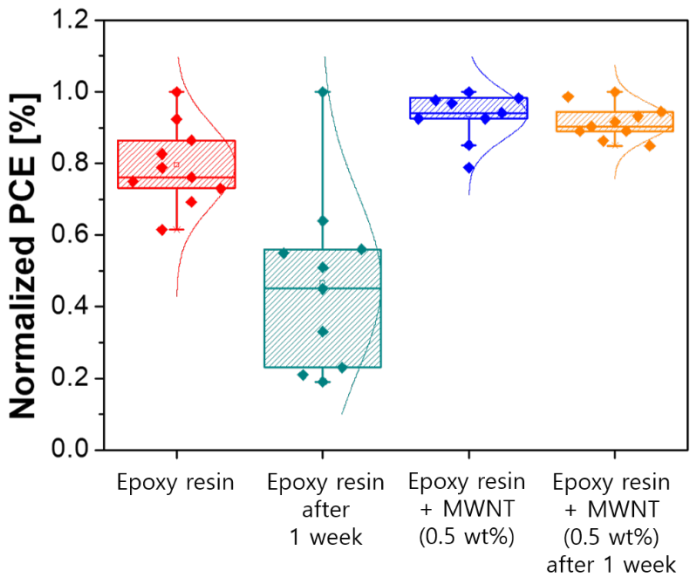



**Figure S14.** Statistical analysis of the 0.5 wt% MWNT-added encapsulated PSCs before and after the stability test.

## 13. Stability of 0.2 wt% MWNT-added Encapsulated Devices

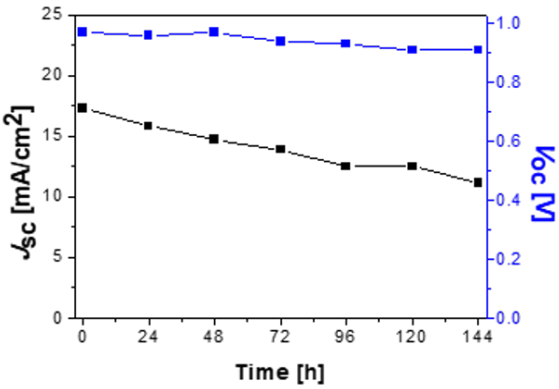



**Figure S15.** Stability of the 0.2 wt% MWNT-added Encapsulated Devices.